

MARKSCHEME

November 2007

BIOLOGY

Higher Level

Paper 2

*This markscheme is **confidential** and for the exclusive use of examiners in this examination session.*

*It is the property of the International Baccalaureate and must **not** be reproduced or distributed to any other person without the authorization of IBCA.*

Subject Details: **Biology HL Paper 2 Markscheme**

Mark Allocation

Candidates are required to answer **ALL** questions in Section A total **[32 marks]** and **any TWO** questions in Section B **[20 marks]** each. Maximum total = **[72 marks]**.

General

A markscheme often has more specific points worthy of a mark than the total allows. This is intentional. Do not award more than the maximum marks allowed for part of a question.

When deciding upon alternative answers by candidates to those given in the markscheme, consider the following points:

- ◆ Each marking point has a separate line and the end is signified by means of a semicolon (;).
- ◆ An alternative answer or wording is indicated in the markscheme by a “/”; either wording can be accepted.
- ◆ Words in (...) in the markscheme are not necessary to gain the mark.
- ◆ Words that are underlined are essential for the mark.
- ◆ The order of points does not have to be as written (unless stated otherwise).
- ◆ If the candidate’s answer has the same “meaning” or can be clearly interpreted as being the same as that in the markscheme then award the mark.
- ◆ Mark positively. Give candidates credit for what they have achieved, and for what they have got correct, rather than penalizing them for what they have not achieved or what they have got wrong.
- ◆ Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
- ◆ Occasionally, a part of a question may require a calculation whose answer is required for subsequent parts. If an error is made in the first part then it should be penalized. However, if the incorrect answer is used correctly in subsequent parts then **follow through** marks should be awarded. Indicate this with “**ECF**”, error carried forward.
- ◆ Units should always be given where appropriate. Omission of units should only be penalized once. Indicate this by “**U-1**” at the first point it occurs. Ignore this, if marks for units are already specified in the markscheme.
- ◆ Do not penalize candidates for errors in significant figures, unless it is specifically referred to in the markscheme.

Section B

Extended response questions - quality of construction

- ♦ Extended response questions for HL P2 carry a mark total of **[20]**. Of these marks, **[18]** are awarded for content and **[2]** for the quality of construction of the answer.
- ♦ Two aspects are considered:
expression of relevant ideas with clarity
structure of the answers.
- ♦ **[1]** quality mark is to be awarded when the candidate satisfies **EACH** of the following criteria. Thus **[2]** quality marks are awarded when a candidate satisfies **BOTH** criteria.

Clarity of expression:

The candidate has made a serious and full attempt to answer all parts of the question and the answers are expressed clearly enough to be understood with little or no re-reading.

Structure of answer:

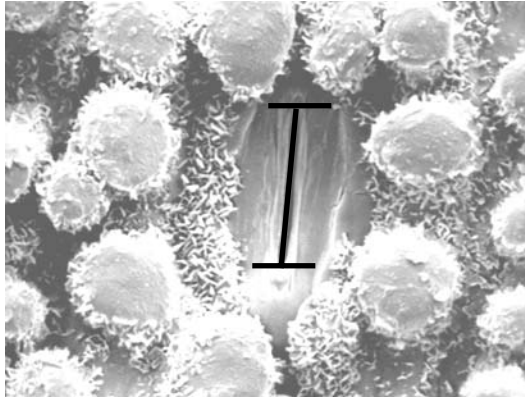
*The candidate has linked relevant ideas to form a logical sequence **within** at least two parts of the **same question** (e.g. within part a and within part b, or within part a and within part c etc. but **not between** part a and part b or between part a and part c etc.).*

- ♦ It is important to judge this on the overall answer, taking into account the answers to all parts of the question. Although, the part with the largest number of marks is likely to provide the most evidence.
- ♦ Candidates that score very highly on the content marks need not necessarily automatically gain the **[2]** marks for the quality of construction (and vice versa).
- ♦ The important point is to be consistent in the awarding of the quality points. For **sample scripts for moderation** the reason why quality marks have been awarded should be stated.
- ♦ Indicate the award of quality marks by writing **Q2, Q1 or Q0 in red** at the end of the answer.

SECTION A

1. (a) (i) 2 mM kg^{-1} (*units required*) [1]
- (ii) 180 (%) *or* $\frac{(28-10) \times 100}{10}$ [1]
- (b) cells in stem absorb water (by osmosis) providing turgidity/turgor pressure [1]
- (c) maintain osmotic balance;
help to maintain turgidity/assist active transport; [1 max]
- (d) active transport means movement against a concentration gradient;
there is no concentration gradient / concentration in xylem should be lower than stem (but it is not); [2]
- (e) diffusion / facilitated diffusion [1]
- (f) sodium ion concentration decreases as you get further away from the base / *vice versa* [1]
- (g) (i) *experiment 1: 17 mM*
experiment 2: 6 mM [1]
Both answers must be correct to receive [1].
- (ii) in experiment 1 (concentration of sodium ions is high because) sodium is continually taken up;
it is lower in experiment 2 because sodium is lost by diffusion into medium (when no sodium in medium);
in experiment 2 there is more water uptake (by osmosis); [2 max]
- (h) sodium ion concentration in experiment 1 is higher close to base;
(moving away from base) sodium ion concentration decreases in experiment 1 but remains constant/decreases slightly in experiment 2;
sodium ion concentration rises in experiment 2 after 100 arbitrary units but continues to decline in experiment 1;
same sodium ion concentration in both experiments at 105 arbitrary units;
lower sodium ion concentration in experiment 1 compared with experiment 2 when close to the top/far from base; [3 max]

(i) (i)



line from top of stoma to bottom

[1]

Award mark if line drawn off the image but it must be 21 (± 1) mm.

(ii) real size = length of line drawn $\div 3000 = 0.007 (\pm 0.0005)$ mm

Units are required, allow for ECF. Also accept answer in cm.

[1]

- (j) humidity decreases transpiration rate because atmosphere is saturated;
 temperature increases transpiration rate because there is more kinetic energy;
 light increases photosynthesis which opens stomata increasing the rate of transpiration;
 wind/air movement lowers concentration outside leaf;

[2 max]

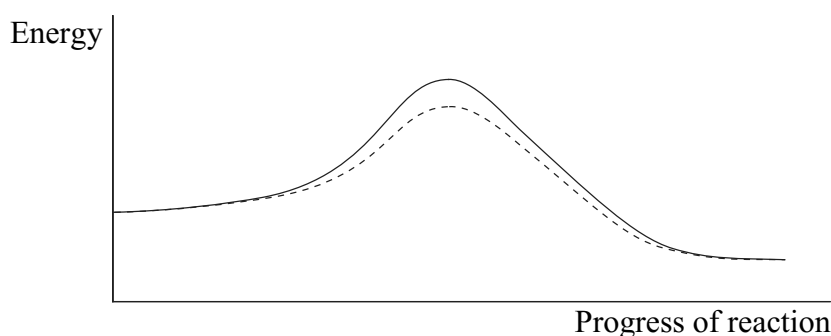
2. (a)

Organelle	Prokaryotic	Eukaryotic
Nucleus		✓
Mitochondrion		✓
Ribosomes	✓	✓

[2]

Award [1] for each correct column.

(b) (i)



Key:

—— original reaction

----- with enzyme

Award [1] if drawn line is same shape as original, starting and finishing in same place and activation energy lower.

[1]

- (ii) enzyme binds to substrate;
lowers activation energy;
by weakening bonds;
making substrate more likely to react;

[3 max]

- (c) one hexose sugar/glucose is converted to two 3-carbon compounds/pyruvate;
at start 2 ATP are used / phosphorylation of glucose;
net gain of 2 ATP / 4 ATP produced in total;
production of 2 NADH + H⁺ / reduced NAD;

[3 max]

3. (a) *advantage:* [1 max]

more specific/less random breeding / better yields / pest/herbicide resistance less likely;
increased resistance to disease / increasing ripening period to allow greater ease with transport of the crop (e.g. fruit);

disadvantage: [1]

genes/proteins potentially harmful/allergenic / genes can cross species barriers / GM crops compete with natural varieties;

[2 max]

- (b) GAG mutated to GTG / A replaced by T;
causing glutamic acid to be replaced by valine;
producing abnormal hemoglobin;
causing red blood cells to have shape of half moon/sickle shape;
capillaries blocked;

[3 max]

SECTION B

Remember, up to TWO “quality of construction” marks per essay.

4. (a) membrane is a lipid bi-layer;
 membrane has hydrophobic interior / lipid hydrophobic tails oriented inward;
 hydrophilic on cytoplasmic and extracellular side / lipid hydrophilic heads oriented outward;
 polar amino acids are hydrophilic/water soluble/attracted to outside of membrane;
 non-polar amino acids are hydrophobic/attracted to inside of membrane;
 integral proteins embedded in the membrane;
 non-polar amino acids cause proteins to be embedded in membrane;
 peripheral proteins associated with surface of membrane;
 polar amino acids cause parts of proteins to protrude from membrane;
 transmembrane proteins have both polar and non-polar amino acids;
 polar amino acids create channels through which (hydrophilic) substances/ions can diffuse;

[6 max]

- (b) cell body (with nucleus);
 long axon (with a dotted/missing section or some indication that the full length is not represented/alternatively axon is at least five times length of cell body);
 motor end plate / synaptic knob / axon terminus (shown with some thickness/cytoplasm present);
 dendrites (shown with some thickness/cytoplasm present);
 myelin sheath / Schwann Cells;
 nodes of Ranier;

[4 max]

Award [1] for each of the above structures clearly drawn and correctly labelled.

- (c) sodium potassium pump establishes resting potential;
 sodium is pumped out and potassium goes in;
 stimulation produces an action potential;
 change in permeability of membrane / depolarized;
 opening of channels letting sodium ions in;
 potassium ions go out (down their concentration gradient) / repolarization;
 potassium channels close and sodium pump starts again / re-establishes resting potential;
 the potential difference is -65 mV or -70 mV ;
 potassium diffuses back out faster than sodium diffuses back in;
 depolarization in one area triggers depolarization in neighbouring region;
 leading to movement along neuron;
 refractory period is the time of recovery from the action potential / incapable of producing a new action potential / unidirectional along neuron;

[8 max]

(Plus up to [2] for quality)

5. (a) arteries carry blood leaving heart;
 so have thick walls to withstand high pressure;
 arteries have muscles to allow elasticity/recoiling;
 arteries have narrow lumen to maintain high pressure;
 capillaries are site of materials exchange;
 capillaries have a single layer of cells so diffusion distance is short;
 capillaries have narrow lumen/width of single blood cell;
 to fit into small places / provide large surface area:volume ratio for gas exchange;
 veins return blood to the heart;
 veins have thinner walls/large lumen (to reduce resistance to flow);
 (allows them to be) pressed by adjacent muscles to move blood;
 veins do not support high pressure (as they carry blood to heart);
 veins have valves to avoid backflow; **[8 max]**
Accept any of the above points if correctly explained using an annotated diagram.
- (b) (i) *HCG*:
 prevents degeneration of corpus luteum;
 stimulates corpus luteum to grow and secrete estrogen/progesterone; **[2]**
- (ii) *LH*:
 stimulates the secretion of testosterone (by the testis);
 stimulates secretion of progesterone;
 inhibits secretion of estrogen;
 causes follicle to develop into corpus luteum / release of egg from follicle; **[2 max]**
- (c) *production*:
 antigens injected into animal;
 B-cells/plasma cells producing antibody (to injected antigen) extracted from animal;
 B-cells fused with tumour cell/melanoma;
 hybridoma produced;
 proliferation of cells/cloning;
 antibodies produced and purified (in fermenters);
use in diagnosis and treatments:
 one example of detection described (e.g. detection of HCG in pregnancy test kits /
 detection of HIV (ELISA));
 an example of treatment described (e.g. injection of monoclonal antibodies in
 person infected with rabies); **[6 max]**
Award [4 max] if the answer addresses production only.

(Plus up to [2] for quality)

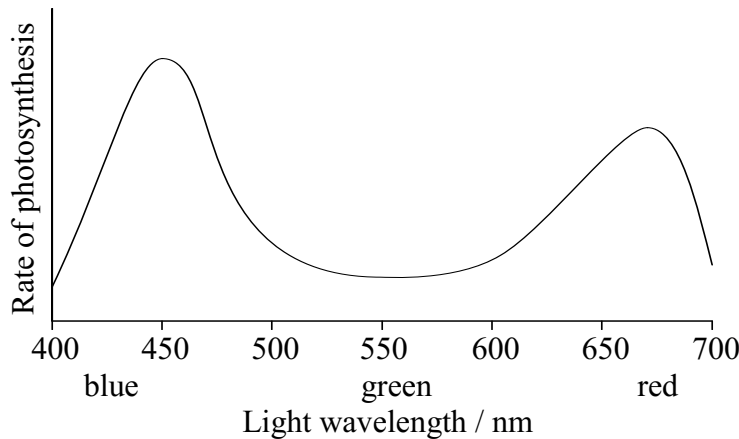
6. (a) meiosis provides opportunities for new combination of genes;
crossing over in prophase I;
due to chiasmata formation;
segments of (non-sister) chromatids are exchanged between homologous chromosomes;
chromosome mutations could occur;
leading to the formation of new combination of alleles (on chromosomes of gametes) /
the formation of new linkage groups;
the random orientation of homologous chromosomes/bivalents in metaphase I;
gives independent assortment of (maternal and paternal) chromosomes in anaphase;
as homologous chromosomes migrate to opposite poles randomly;
 2^{23} possible gametes;
non-disjunction could occur leading to diploid gametes/trisomy;
random orientation in metaphase II;
gives the independent assortment of chromatids in anaphase II; [8 max]
Accept any of the above points if correctly explained using an annotated diagram.
- (b) Chi squared test is used to determine whether a difference between expected and observed results is due to chance;
tests the significance of data;
data must consist of discrete / discontinuous variables;
between observed (O) and expected result (E);
the hypothesis to be tested (the null hypothesis) is that there are no significant differences between them;
$$(\text{Chi-squared}) = \sum \frac{(O - E)^2}{E};$$

example given *e.g.* values for O and E in cross between tall and dwarf;
establish degree of freedom;
statistical tables used to identify probability;
critical value of 5%; [6 max]
- (c) characteristic caused by the combined effect of more than one gene;
example of polygenic inheritance;
linked to human melanin production;
skin colour shows continuous variation;
the more loci/alleles concerned, the greater the number of phenotypic classes;
giving different shades of skin colour; [4 max]

(Plus up to [2] for quality)

7. (a) x-axis labelled light wavelength/frequency and y-axis labelled rate of photosynthesis;
 curve increases, decreases and then increases again to decrease again;
 peak approximately at 450 nm / blue region;
 peak approximately at 670 nm / red region;
 first peak higher than second peak;

e.g.



[4 max]

Award [3 max] if light wavelengths are incorrectly indicated e.g. red has a shorter wavelength than blue light.

- (b) light dependent reaction occurs in the thylakoid membrane;
 thylakoids provide a large surface area;
 pigments/chlorophyll is located in the membrane;
 in groups of (hundreds of) molecules called photosystems;
 folds in thylakoid allow photosystems to be close to each other;
 electron carriers embedded in membrane;
 NADP⁺ accepts two high energy electrons and an H⁺ from stroma to form NADPH;
 electron flow causes H⁺ to be pumped into thylakoid space;
 proton gradient formed in space between thylakoids;
 H⁺ flow back through ATP synthase/synthetase channels to produce ATP;
 coupling of electron transport produces ATP / chemiosmosis;
 ATP synthase/synthetase embedded in thylakoid;
 photolysis of water occurs in thylakoid space;

[8 max]

Accept any of the above points if correctly explained using an annotated diagram.

(c) *effects: [5 max]*

global warming/causing the earth to be warmer;
leads to range/altitude shifts of species;
increased competition;
rising of sea levels affects coastal ecosystems;
melting ice caps leads to changes in salinity/upwelling/currents;
increased frequency of coral bleaching;
changes in weather patterns / climate could affect biome distribution in long-run;
increased microbe activity in permafrost;
rapid ecological change favours emergent pathogens/pest species;

measure: [1]

carbon dioxide absorption by photosynthesis must be encouraged / avoid deforestation /
induce reforestation / nutrients in oceans to induce growth of algae / burning of fossils
fuels must be reduced / use of solar energy / insulating homes / any other suitable
measure;

[6 max]

(Plus up to [2] for quality)
